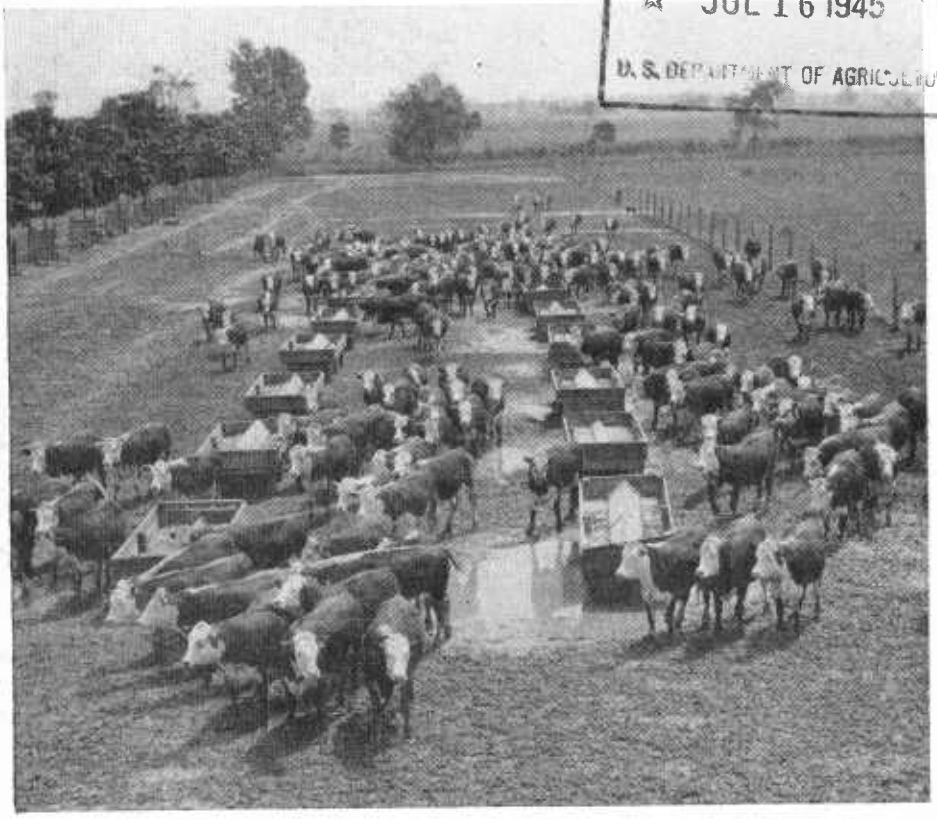
FEEDING COTTONSEED PRODUCTS TO LIVESTOCK



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IN REGIONS where much corn, stover, fodder, timothy, or other carbohydrate feed is used, it is important to use some feed that is high in protein, such as cottonseed meal.

Cottonseed meal stimulates the appetite of fattening animals receiving feeds of low palatability and consequently promotes greater gains in weight.

Cottonseed cake or meal may be used satisfactorily as a supplemental feed for fattening beef cattle on pasture.

Cottonseed meal is a valuable protein feed for dairy cattle. The quality of the protein which it contains is as good as that in other protein-rich supplements of vegetable origin that are generally used for feeding dairy cows. Cottonseed meal can be added to the concentrate mixture to provide enough protein to balance the ration, without injury to the cow.

Hogs may be fed limited quantities of cottonseed meal as a protein supplement.

Horses may be fed cottonseed products in reasonable quantities and with caution.

Procure prices on various grades of cottonseed meal or cake and choose the feed which supplies a pound of protein at the least cost.

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FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

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VALUE OF COTTONSEED PRODUCTS AS LIVESTOCK FEEDS

COTTONSEED PRODUCTS have been extensively fed to stock in the South for many years. More recently their use has become general in many sections outside the Cotton Belt. It is estimated that approximately 2 million tons of cottonseed meal have been used annually for feeding purposes in the United States during the 10-year period ended December 31, 1944.

Other protein feeds, such as soybean meal, peanut meal, copra meal, linseed meal, milk byproducts, fish meal, and meat meal, are available as protein supplements. Roughly these feeds are similar in nutritive value. They differ somewhat in the relative protein value and in vitamins and inorganic matter.

COMPOSITION OF COTTONSEED PRODUCTS

Many cottonseed products, both concentrates and roughages, are used as livestock feeds. All the concentrate products have the same general characteristics and qualities, their chemical composition depending mainly on the form of manufacture and the thoroughness in separating out the hulls. Among the more common cottonseed products used as feeds are cottonseed meal and cake, whole-pressed cottonseed, and cottonseed hulls. Table 1 gives analyses representing these products, marketed by manufacturers to conform to the definitions adopted by the Association of American Feed Control Officials.

[1] This is a revision of and supersedes former editions of the same title by E. W. Sheets and E. H. Thompson. Mr. Sheets left the Department in October 1934. Mr. Thompson died October 6, 1924. R. E. Hodgson prepared the section on Dairy cows in the current edition.

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Untreated cottonseed contains a substance called gossypol, which is toxic to animals. This substance is made inactive by cooking the seed after the addition of water. Similarly, the cooking and expelling processes to which cottonseed meal is subjected in order to remove the oil are in large measure destructive to the toxic principle in the raw seed. The extent to which each step in the varied methods of manufacture of cottonseed oil and cottonseed meal affects the toxicity of the meal is not yet determined, and it is possible that when this knowledge is obtained and applied, the meal can be fed economically in larger quantities than at present.

TABLE 1.—*Composition of cottonseed products (pounds of nutrients in 100 pounds*

Product	Water	Ash	Crude protein	Carbohydrates		Fat (ether) extract
				Fiber	Nitrogen-free extract	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Cottonseed	9.1	4.0	19.6	18.9	28.3	20.1
Cottonseed meal and cake:						
36 percent protein	7.5	5.4	37.1	14.4	29.8	5.8
41 percent portein	7.4	6.2	41.0	10.8	28.1	6.5
43 percent protein	7.0	5.8	43.9	10.5	26.1	6.7
Whole-pressed cottonseed	6.5	4.8	28.3	22.5	31.9	6.0
Cottonseed feed:						
41 percent protein	8.0	6.4	41.7	10.3	27.7	5.9
Cottonseed hulls	8.7	2.6	3.5	46.2	38.0	1.0

Cottonseed is a good source of protein, potash, and phosphorus, but is deficient in calcium and carotene (vitamin A). An adequate quantity of calcium is especially important to milking or nursing animals and to young stock and may be supplied satisfactorily by legume hays or as a mineral supplement. Some nutritional failures attributed to cottonseed meal have been the result of using it with poor-quality roughages, such as hulls or straw. A satisfactory ration in which cottonseed meal is used as the concentrate should contain an adequate supply of carotene and possibly certain other nutritive elements supplied by such roughages as legume or other hays of good quality or by pasturage. The value of cottonseed meal lies primarily in its protein content and the principal basis for its use in rations should be to help make up any protein deficiency.

GRADES AND CLASSES OF COTTONSEED PRODUCTS

Cottonseed (uncrushed) was formerly used extensively as a feed for livestock. Its value as a source of cottonseed oil and its utilization for commercial purposes have greatly decreased the amount fed in the form of seed. Cottonseed products have largely taken the place of the seed as a feedstuff. Feeding tests have indicated that 1 pound of good-quality cottonseed meal is equal to nearly 2 pounds of cottonseed as a feed for fattening steers. Large rations of cottonseed tend to produce scours, but when used in quantities up to 5 or 6 pounds there is little or no trouble of this sort.

Cottonseed contains about 20 percent each of fat or oil and crude protein. Compared with a good grade of cottonseed meal it contains about half as much protein and about three times the content of oil.

A ton of cottonseed will yield approximately the following quantities of products: Linters or short fiber, 110 pounds; hulls, 514 pounds;

cake or meal, 954 pounds; crude oil, 303 pounds; with dirt and loss in manufacture amounting to 119 pounds.

Cottonseed cake or the meal resulting from the grinding of the cake is the product resulting from the pressing or extracting of the oil from the cottonseed kernel with only a small portion of the hull remaining. The definitions of the Association of American Feed Control Officials further stipulate that the cake or meal must contain "not less than 36 percent of crude protein."

Cottonseed cake and cottonseed meal are practically one and the same thing; that is, the meal is the cake in a ground form. The meal is most commonly used, but the cake has a distinct advantage in certain cases. The cake is preferred by those who feed their cattle in the open where the wind may blow the meal away. On the range or pasture the cake is often broken up and fed in troughs or spread on the ground. If meal were used, the loss in feeding in this manner would be very large.

In recent years a considerable tonnage of cottonseed cake has been broken into different-sized pieces and then marketed. The products include nut-size, sheep-size, pea-size, and pebble-size. In addition the cake has been ground and processed through a cubing or pelleting machine and marketed as cottonseed cubes or pellets.

When whole, unhulled cottonseed is pressed, the resulting product is known as whole-pressed cottonseed. The crude protein is necessarily considerably lower in such a product than in cottonseed cake or meal.

Cottonseed hulls are the roughage product of cottonseed-oil manufacture. The hulls are removed from the cottonseed before the oil is extracted. They have a very low-protein content and should be fed only in connection with protein-rich feeds. As a roughage the hulls have a lower feeding value than oat straw or corn stover, but are valuable where no other roughage is available. This product is used extensively in the South, especially for steer feeding.

Cottonseed-hull bran is ground cottonseed hulls from which the lint has been removed. The feeding value of the bran is not appreciably greater than that of ordinary cottonseed hulls.

ECONOMY OF USING HIGH-GRADE COTTONSEED PRODUCTS

Cottonseed products containing a high percentage of protein command relatively high prices, but judged from the cost of the protein contained, they are comparatively cheap. These products are usually purchased for their protein content, and prices paid should be based on the protein contained in them. To show the value per pound of the protein in feeds at various prices and containing varying guaranteed analyses of protein, table 2 has been prepared.

The poorer grades of cottonseed meal or cake usually sell at prices only a little lower than those of the higher-grade products. By obtaining commercial prices on both high-grade and low-grade products and referring to table 2, one can ascertain approximately which feed will provide protein at the least cost. It must be remembered, however, that the feeding values of different feeds having essentially the same coefficients of digestibility are not exactly proportional to their respective protein contents. A low-protein feed usually has a higher content of carbohydrates, which may partially make up in feeding value for the difference in protein content.

Good cottonseed meal contains three times as much digestible

TABLE 2.—*Cost per pound of protein in feeds at various prices per ton*

Cost of feed per ton	Percent of protein in feeds										
	12	16	20	24	28	32	36	38	41	43	45
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
$10.00	4.17	3.13	2.50	2.08	1.79	1.56	1.39	1.32	1.22	1.16	1.11
15.00	6.25	4.69	3.75	3.13	2.68	2.34	2.08	1.97	1.83	1.74	1.67
20.00	8.33	6.25	5.00	4.17	3.57	3.13	2.78	2.63	2.44	2.33	2.22
25.00	10.42	7.82	6.25	5.23	4.47	3.91	3.47	3.29	3.05	2.91	2.77
30.00	12.50	9.38	7.50	6.25	5.36	4.69	4.16	3.95	3.66	3.48	3.38
35.00	14.58	10.94	8.75	7.29	6.25	5.47	4.86	4.61	4.26	4.07	3.89
40.00	16.67	12.50	10.00	8.33	7.14	6.25	5.55	5.26	4.88	4.65	4.44
45.00	18.75	14.06	11.25	9.38	8.03	7.03	6.25	5.92	5.49	5.23	5.00
50.00	20.83	15.63	12.50	10.42	8.93	7.81	6.94	6.58	6.09	5.81	5.55
55.00	22.91	17.19	13.75	11.46	9.82	8.59	7.64	7.24	6.71	6.40	6.11
60.00	25.00	18.75	15.00	12.50	10.71	8.38	8.33	7.89	7.32	6.97	6.67
65.00	27.08	20.31	16.25	13.54	11.67	10.16	9.03	8.55	7.92	7.56	7.22
70.00	29.16	21.87	17.50	14.58	12.50	10.94	9.72	9.21	8.53	8.14	7.78
75.00	31.25	23.44	18.75	15.62	13.39	11.72	10.41	9.87	9.14	8.72	8.33
80.00	33.33	25.00	20.00	16.67	14.28	12.50	11.11	10.53	9.75	9.32	8.89
85.00	35.41	26.56	21.25	17.71	15.18	13.28	11.80	11.18	10.36	9.88	9.44

protein and as much digestible carbohydrates and fat combined as there is in wheat bran. One pound of cottonseed meal will balance as much corn as 3 pounds of bran.

COTTONSEED PRODUCTS FOR VARIOUS CLASSES OF LIVESTOCK

The rations given in the succeeding pages may be used as the average and may be adjusted to suit local conditions. If the suggested rations cannot be used, one may substitute other feeds of the same general character as those included in the rations outlined. These rations are primarily designed to show the proper proportions in which to use cottonseed products and no attempt is made to cover all conditions.

In discussions of feeding cottonseed products, the quantities for the different classes of animals are given in pounds. While it is important to weigh the meal as fed, yet it may be entirely satisfactory merely to weigh at frequent intervals the contents of a certain measure or vessel. Table 3, giving weights and measures, may be helpful along this line.

TABLE 3.—*Equivalent weights and measures of cottonseed products*

Product	1 quart weighs—	1 pound measures—
	Pounds	*Quarts*
Cottonseed	0.8	1.3
Cottonseed meal	1.5	.7
Cottonseed hulls	.3	3.3

FATTENING CATTLE IN THE DRY LOT

Fattening or carbohydrate feeds should be fed in conjunction with roughages and supplemented with feeds rich in protein. In many of the fattening areas the protein supply is limited, and accordingly is one of the factors of most importance to the cattle feeder. When there is an abundance of legume hay, such as clover or alfalfa, and its market value is not excessive, it is unnecessary to supply any additional protein in the form of a meal or cake. However, when protein can be supplied more cheaply in the latter form, it may be advisable to replace part of the hay with a meal or cake.

Protein concentrates, such as cottonseed meal or cake, are used generally in rations in which straw, stovers, or silage makes up the roughage. In buying cottonseed products as a source of protein it is usually advisable to purchase the feed that will supply protein most cheaply. This can be easily determined if the percentage of protein and price per ton are known. For example, cottonseed meal having a protein content of 45 percent and priced at $35 a ton will supply protein more cheaply than 36 percent meal at $25 a ton (table 2).

In many sections of the South there is a shortage of carbohydrate feeds (grains) for fattening purposes, and under these conditions considerable quantities of cottonseed hulls are fed in conjunction with cottonseed meal. This type of ration is more adaptable to cattle 2 years old and over, and for short feeding periods.

Suggested rations for fattening steers averaging 600 pounds in weight

Ration 1	Pounds
Corn or barley (ground)	11
Mixed hay	4
Cottonseed meal	2

Ration 2	
Corn	10
Oat straw	4
Corn silage	10
Cottonseed meal	2

Ration 3	Pounds
Grain sorghums	10
Sorgo fodder	6
Cottonseed meal or cake	2

Ration 4	
Corn	5
Molasses	2
Cottonseed hulls	14
Cottonseed meal	3

FATTENING CATTLE ON GRASS

Cottonseed products are commonly used as supplements in the fattening of cattle on grass. Cottonseed cake is frequently used as the sole supplemental feed, but more often cottonseed meal or cake is used in a mixture with corn or other grain. A desirable mixture for use as a supplement for cattle on grass is 8 parts by weight of corn or other grain and 1 part of cottonseed meal or cake. Cattle fattened on grass with a supplement are usually allowed all the feed they will eat once a day in addition to grass. Usually cattle on pasture will not eat more than one-half the feed that would ordinarily be eaten in dry-lot feeding.

WINTERING CATTLE

For cattle the use of cottonseed meal is ordinarily confined to the winter period, and then only in amounts sufficient to supply the necessary protein. It is especially valuable to use in connection with cheap roughages and silages. For cattle weighing from 500 to 750 pounds, from 1 to 2 pounds of the meal is enough to balance most roughage rations properly. If legume hays, such as alfalfa or clover, constitute half or more of the roughage ration, there is little or no need of the use of cottonseed meal.

Few combinations are more economical than a ration of corn silage, straw, and cottonseed meal for wintering cattle. One to two pounds of cottonseed meal combined with whatever silage and straw they will eat should keep them in thrifty condition. The cost of wintering such cattle can usually be lessened by permitting them to run in the stalk fields or on pastures reserved for winter and giving them feed at night only.

Suggested rations for wintering cattle averaging 650 pounds in weight

Ration 1	Pounds
Corn (or sorgo) silage	20
Oat or wheat straw	Unlimited.
Cottonseed meal	1

Ration 2	
Corn (or sorgo) silage	20
Cottonseed meal	1
Straw or stover	Unlimited.

Ration 3	Pounds
Cottonseed hulls	15
Grass hay	5
Cottonseed meal	2

Ration 4	
Cottonseed cake	1
Silage, to supplement winter pastures	15 to 20

BREEDING CATTLE

In feeding cottonseed meal to beef cows, two classifications may be made—dry cows and cows that nurse calves. The amount of cottonseed meal that should be fed to dry cows depends on the other feeds used. From 1 to 1½ pounds of cottonseed meal or cake may be fed daily with other feeds, such as corn silage and hay. Where corn silage is available, a good ration for breeding cows is 25 to 30 pounds silage, from 1 to 1½ pounds cottonseed meal or cake, and other roughage, such as stalks in the field, corn stover, hay, or straw.

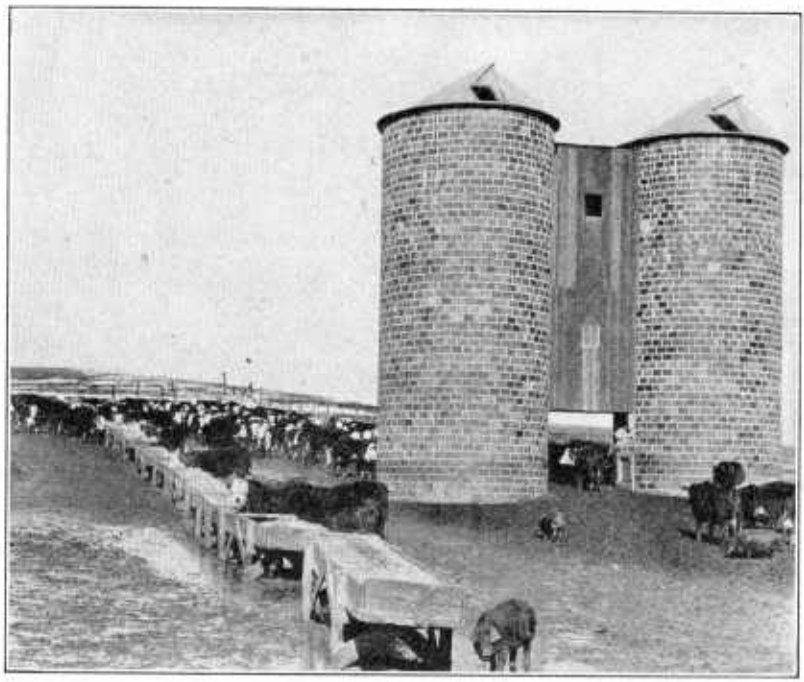

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FIGURE 1.—Cottonseed meal, straw, and corn silage make a good feed combination for beef cattle. The meal supplies the protein that the silage lacks.

Cows that are nursing calves should receive more protein supplements than dry cows, but the amounts fed should not be greater than is necessary to balance properly the other feeds, which may consist largely of roughages. Ordinarily beef cows raising calves are fed not more than 2 pounds of supplements each daily, and then only during the winter period.

It is customary to feed beef bulls from ½ to 1 pound of concentrates per 100 pounds of live weight in addition to the winter range (fig. 2). The concentrates may consist of any single grain or mixture of grains together with cottonseed meal in the ratio of about 4 or 5 to 1.

Suggested rations for wintering beef breeding cows averaging 1,000 pounds in weight

Ration 1	Pounds
Corn silage	30
Cereal straw or stover	Unlimited.
Cottonseed meal	1½

Ration 2	
Corn (or sorgo) silage	25
Cottonseed meal	1 to 1½
Winter pasture.	

Ration 3	Pounds
Grass hay or stover	18
Cottonseed meal or cake	2

Ration 4	
Sorghum silage	30
Sorghum stover or cercal straw	Unlimited.
Cottonseed meal or cake	1½

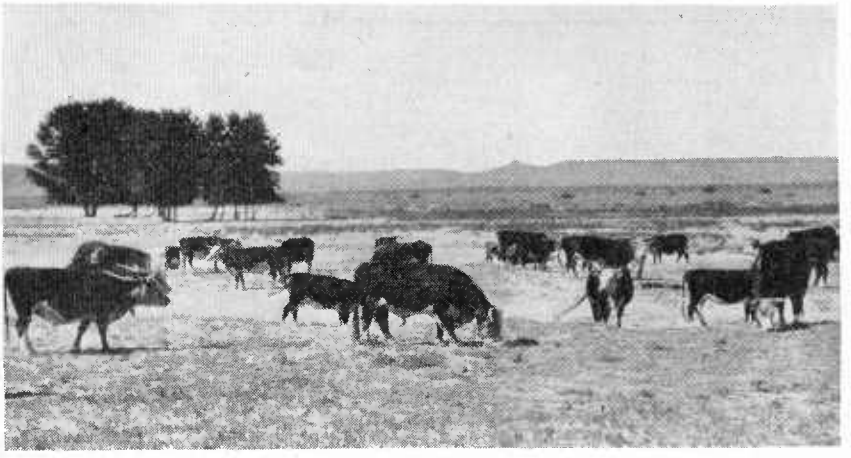

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Figure 2.—Range cattle being fed cottonseed cake as a supplement to pasture.

DAIRY COWS

Cottonseed meal is an excellent feed for dairy cows. The protein it contains is as valuable for milk production, pound for pound, as the protein in linseed meal, soybean meal, peanut meal and other high-protein concentrates. It can be fed in as large quantities as are needed to balance the ration without fear of injury to the cow. Like nearly all other concentrate feeds, cottonseed meal does not contain any appreciable amount of carotene, the substance which the animal transforms into vitamin A. If the cottonseed meal is fed along with cottonseed hulls, straw, or poor-quality hays, which also lack carotene, the cow will suffer from a deficiency of vitamin A. To prevent this, part of the roughage should consist of nicely cured hays, good silage, pasturage, or other green forage, which are rich in carotene. Where cottonseed meal is plentiful and cheap in comparison with farm grains, the cow can be fed relatively large amounts of cottonseed meal provided she also gets plenty of good roughage.

When large quantities of cottonseed meal and a poor roughage are fed to dairy cows, the butter produced is hard, tallowy, and light in

color; however, moderate quantities fed with good roughage do not result in butter of undesirable quality. Some kinds of feeds tend to result in a soft butter and the addition of some cottonseed meal to them in the ration results in a butter of satisfactory body.

TABLE 4.—*Suggested grain mixtures containing cottonseed meal to be fed with different roughages*

Roughage	Approximate protein content desired in grain mixture	Grain mixture			
		Ground corn	Ground oats	Wheat bran	Cottonseed meal
	Percent	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Good-quality leafy legume hay or silage; or abundant immature pasture herbage	12	400	200	200	
Average-quality legume hay or silage alone; or good-quality legume hay or silage with corn or sorghum silage	14	350	200	200	50
Average-quality legume hay or silage with corn or sorghum silage; or good quality early cut mixed hay [1] alone; or mixed pasture herbage [1] grazed at a hay stage	16	300	200	200	100
Good-quality mixed hay [1] or silage with corn or sorghum silage; or average-quality mixed hay alone [1]; or good-quality early cut grass hay alone	18	250	200	200	150
Average-quality grass hay or silage alone or with corn or sorghum silage; or straight grass pasture herbage grazed at a hay stage	20	200	200	200	200

[1] Half grass and half legume.

In the above mixtures, ground corn can be partially or wholly replaced by feeds such as hominy feed, corn-and-cob meal, ear-corn chops, grain-sorghum head chops, dehydrated sweetpotato meal, dried citrus peel-and-pulp or dried beet pulp. Oats can be replaced by ground or rolled wheat or barley, ground grain sorghums, or grain-sorghum head chops. Wheat bran can be replaced by rolled or ground wheat, or oats or by rice bran.

If whole pressed cottonseed or low-grade cottonseed meal is fed, the quantity included in each grain mixture should be increased by about 50 pounds. In phosphorous-deficient areas it may be necessary to supply additional phosphorus if the grain mixture contains less than 25 percent of wheat bran and cottonseed meal combined. This can be provided by steamed bonemeal, dicalcium phosphate, or some other source of phosphorus according to the recommendations of the local State agricultural experiment station.

The quantity of grain to feed will depend upon the quantity and quality of the pasturage and other roughages available. Good pastures and roughages provide the best and cheapest feeds for a dairy cow, and the cow should be supplied with all of these that she can consume. Cows on pasture which provides an abundance of immature herbage will need grain for all production above 1 pound or so of butterfat per day; or for all milk produced above 30 pounds for Holsteins, 24 pounds for Ayrshires, Brown Swiss, and Milking Shorthorns, 20 pounds for Guernseys, and 18 pounds for Jerseys. Cows on less abundant pasture supplemented by plenty of good roughage or cows getting all the good roughage they will eat during the winter months will usually need grain for all production above one-half pound of butterfat per day; or for all milk produced above 15 pounds for Holsteins, 12 pounds for Ayrshires, Brown Swiss, and Milking

Shorthorns, 10 pounds for Guernseys, and 9 pounds for Jerseys. For each pound of milk produced above the quantities stated, 0.40 pound of a good grain mixture will be needed by Holstein cows, 0.45 pound by Ayrshire, Brown Swiss, and Milking Shorthorn cows, 0.50 pound by Guernsey cows, and 0.55 pound by Jersey cows.

If the roughage is poor in quality, heavier grain feeding may be required.

YOUNG CALVES

Very young calves are susceptible to injury from the feeding of cottonseed meal. The maximum amount fed at 6 months of age should not exceed a half pound daily. Calves running with their dams or being hand-fed on plenty of skim milk to 6 months of age can be raised on good hay and a mixture of low-protein farm grains or without wheat bran. Calves raised on moderate amounts of milk to 90 or 120 days with good hay will need a grain mixture containing 14 to 16 percent total protein. Calves raised on very limited quantities of milk to 30 or 60 days will need a grain mixture containing 18 to 20 percent protein. The grain feeding of hand-fed calves is usually started at about 2 weeks of age, and between 4 and 6 months of age calves getting skim milk will be eating 3 pounds of grain per day, while those getting no milk will be eating 4 or more pounds per day. By substituting linseed meal or soybean meal for half of the cottonseed meal, the same grain mixtures used for feeding cows will be suitable for feeding young calves.

BULLS AND HEIFERS

Bulls and heifers of the dairy breeds intended for breeding purposes should be supplied with plenty of protein and mineral matter. With abundant immature pasturage or good-quality roughage, animals 6 to 9 months of age will not need more than 3 pounds of concentrates per day and beyond 9 months they will make good growth without any concentrates. The concentrates can consist entirely of low-protein farm grains with or without wheat bran. If pasturage or roughages are of poor quality the animals may need as much as 5 pounds of concentrates or more per day. Cottonseed meal can be used as a protein supplement after the animals have reached 6 months of age. The quantity of cottonseed meal or other supplemental protein needed in the grain mixture will be about the same for the kind of roughage fed as for milking cows.

HOGS

Cottonseed meal can be used effectively as a protein supplement in hog rations, provided excessively high levels are not employed. It is advisable to use the meal in combination with other protein-rich feeds. Following are some suggested formulas of protein-mineral mixtures suitable for hogs on pasture and in dry lot.

It is advisable to use iodized salt in goiterous areas. These formulas contain 35 to 40 percent of crude protein depending on the level of tankage or fishmeal, both of which are generally higher in protein than the plant-source feeds. The protein mixtures should be fed along with corn, sorghum grains, barley, or combinations of grains, and may be fed in self-feeders (figure 3) either separate from the grain or mixed. When the latter course is followed, the proportions should be adjusted to give a protein content in accordance with good practice.

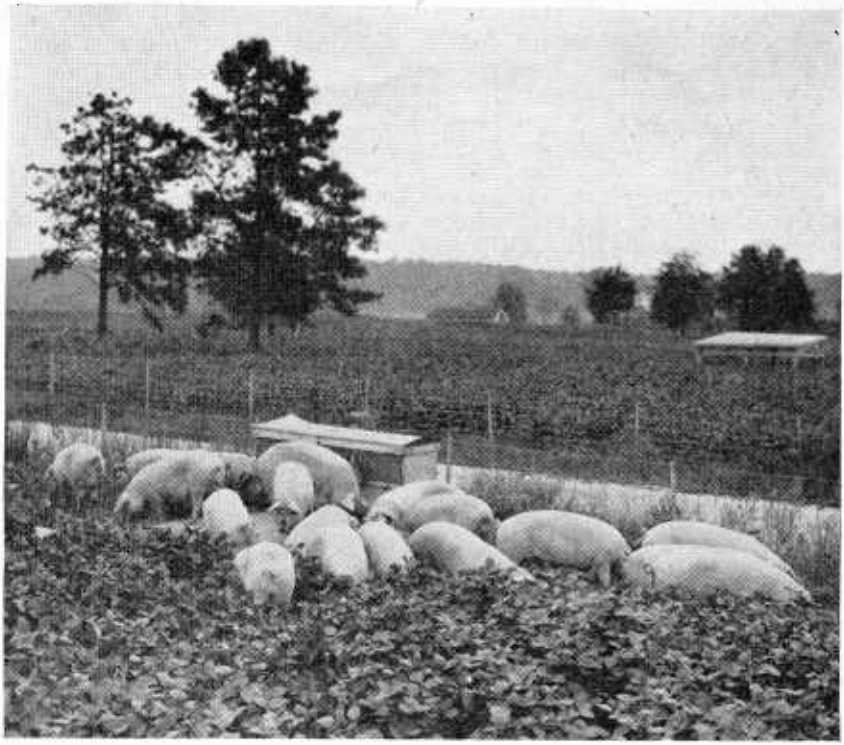

FIGURE 3.—Growing pigs on soybean pasture with access to a self-feeder containing cottonseed meal, minerals, and other supplements.

TABLE 5.—*Suggested mixtures for growing and fattening pigs*

Ingredient	Pigs on pasture weighing—		Pigs in dry lot weighing—	
	Under 75 pounds	Over 75 pounds	Under 75 pounds	Over pounds
	Pounds	*Pounds*	*Pounds*	*Pounds*
Tankage or fishmeal	20		25	10
Cottonseed meal	25	30	25	30
Soybean meal	25	34	25	35
Peanut meal	25	30		
Alfalfa leaf meal (or ground alfalfa hay)			20	20
Ground limestone	3.75	4.5	3.75	3.75
Salt	1.25	1.5	1.25	1.25

HORSES

Cottonseed meal may be used as a protein supplement in rations for horses and mules. It is recommended that its use be restricted to limited amounts and that care be exercised that only meal of good quality be fed.

Cottonseed meal has met with some disfavor among horse feeders because of its reputed tendency to produce digestive disturbances. There may be some basis for this prejudice since horses have undoubtedly been killed by the feeding of excessive amounts of cottonseed meal. In many cases of such results, however, the quality of the meal has been poor and the horses may have been poisoned by the moldiness of the feed. It is well known that horses are very

susceptible to injury from eating moldy feed and this is particularly so in the case of moldy cottonseed products.

Good-quality cottonseed meal when properly used has been found to give satisfactory results with both horses and mules. It is commonly used in the South in combination with corn or with black-strap molasses and corn or other grain. The amount used in probably best limited to 1 to 1½ pounds per 1,000 pounds of live weight although in some cases it has been fed successfully at higher levels. It is safest that its use be started at a level not exceeding ¼ pound per day and gradually increased to the full allowance. The meal is not very palatable to horses and should be well incorporated with other feeds. Its greatest usefulness is as a protein supplement to carbonaceous feeds such as corn.

Suggested rations for a 1,000-pound horse at medium work

Ration 1	Pounds
Oats	12
Timothy hay	12
Cottonseed meal	¾

Ration 2	
Shelled corn (dent)	8
Wheat bran	4
Mixed timothy and clover hay	10
Cottonseed meal	¾

Ration 3	Pounds
Rolled barley	10
Oat hay	12
Cottonseed meal	1

Ration 4	
Shelled corn (dent)	9
Molasses (cane)	2
Cowpea hay	6
Sorgo fodder	6
Cottonseed meal	1

SHEEP

In feeding sheep it is highly important to balance properly the rations used. Protein-rich concentrates can be used advantageously for this purpose (fig. 4). Cottonseed meal and cake have been used for fattening sheep with satisfactory results. In limited quantities they have been found one of the best types of protein-rich supplements for sheep.

FIGURE 4.—Carload of grade lambs from range ewes. Fed by Purdue University Agricultural Experiment Station. These lambs received a ration consisting, by weight, of seven parts of corn and one part of cottonseed meal fed with corn silage and clover hay.

Cottonseed meal and cake are also used to advantage in limited quantities for breeding ewes. One-half pound a day meets their requirements for a protein-rich concentrate, although these feeds are usually fed in connection with grains, forming from 10 to 15 percent of the grain ration.

Sheep should be started on cottonseed products in small quantities. Lambs when on full feed should receive not more than one-third of a pound a day when fed on other concentrates, and only one-eighth to one-fourth of a pound in combination with other grains. It is advisable to use cottonseed meal in connection with corn, oats, or similar grain. Sheep usually relish cottonseed cake more than the finely ground meal.

Suggested rations for a 60-pound fattening lamb

Ration 1	Pounds
Shelled corn	1. 0
Grass hay	1. 0
Cottonseed meal	. 25

Ration 2	Pounds
Shelled corn	1. 2
Alfalfa	. 4
Corn silage	. 6
Cottonseed meal	. 2

Ration 3	Pounds
Corn silage	1. 2
Barley	1. 0
Cottonseed meal	. 2
Clover hay	. 6

Ration 4	Pounds
Barley	. 6
Wet beet pulp	3. 0
Cottonseed meal	. 25
Prairie hay	1. 0

POULTRY

Cottonseed meal is a fair source of protein for diets to be fed to growing chicks, but it should not be used in diets for laying chickens because of the effect it has on yolk color. When large quantities of cottonseed meal—30 percent or more—are included in the diet of laying hens, most of the eggs will have mottled yolks. When such eggs are stored for a few weeks, the yolks may acquire a brown or chocolate color. Even if as little as 5 percent of cottonseed meal is fed, mottling and off colors may develop in the yolks after they have been stored a few months.

Although cottonseed meal should not be fed to laying chickens, it may be used to advantage in diets for growing chicks. The following mash diets contain the proper quantities of cottonseed meal.

All-mash chick-starting diet:	Pounds
Ground yellow corn	42. 0
Finely ground oats or wheat middlings	10. 0
Soybean meal	21. 0
Dried whey	5. 0
Fish meal	2. 5
Alfalfa leaf meal	6. 0
Cottonseed meal	10. 0
Steamed bonemeal	1. 1
Ground limestone or oyster shell	1. 3
Manganized salt [1]	1. 0
Vitamin A and D feeding oil [2]	0. 1
Total	100. 0

Growing mash, to be fed with grain after the chicks are 6 weeks old:	Pounds
Ground yellow corn	35. 0
Finely ground oats or wheat middlings	10. 0
Soybean meal	20. 0
Dried whey	6. 5
Fish meal or meat meal	3. 0
Alfalfa leaf meal	7. 0
Cottonseed meal	13. 0
Ground limestone or oyster-shell	2. 0
Manganized salt [1]	1. 5
Steamed bonemeal	2. 0
Vitamin A and D feeding oil [2 3]	0. 2
Total	100. 2

[1] The manganized salt is prepared by mixing 100 parts of salt and 2.2 parts of anhydrous manganous sulfate or 3.2 parts of manganous sulfate tetrahydrate.

[2] Feeding oil should contain 400 A. O. A. C. chick units of vitamin D and 2,000 International units of vitamin A per gram.

[3] To be fed here only if chicks do not have access to direct sunlight.

The grain to be fed with the above starting and growing mash may consist (1) entirely of corn, (2) of equal parts of corn and wheat, (3) of equal parts of corn, wheat, and oats, (4) of 2 parts of corn and 1 part of oats, or (5) of any other suitable grain or combination of grains.

COTTONSEED MEAL OR CAKE FOR PASTURE FEEDING

For years feeders, of the Southwest particularly, have used from 1 to 2 pounds of cottonseed cake for feeding cows and steers on range in the fall and winter. Somewhat more cottonseed cake or some roughage as suggested on pages 6 and 7 should be fed when the grass is covered with snow and also during periods of grass shortage. The fattening of cattle on grass with cottonseed cake during the spring and summer months has been found during more recent years to be an economical practice. The cake is usually preferred to the meal for grass feeding. In regard to feeding cake in preference to meal, a former publication of the Bureau is here quoted.

> There are several advantages in feeding cake in place of meal, especially in summer feeding. A rain does not render the cake unpalatable, but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days, whereas the meal, when fed in the open pasture, is sometimes wasted on account of the high winds. Furthermore, the cake requires chewing before being swallowed and therefore must be eaten very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. When cottonseed meal is fed, the greedy steer often scours, because he can bolt the meal and get more than his share; this not only injures the steer but makes the bunch "feed out" unevenly.

In experiments conducted in the Southeast by the Bureau of Animal Industry in which the cake was fed in troughs in the pasture, it was found after several years' work that the feeding of cottonseed cake to cattle on pasture caused the cattle to fatten more rapidly, to develop greater finish, and to make greater profits in most cases than with similar cattle which received pasture alone. The value of the cake as a supplement to pasture, of course, depends to a considerable extent on the nature of the pasture grasses, its use for legumes not being so profitable as with true grasses. As a rule, however, the feeding of cottonseed cake on good grass pasture is not highly profitable. The stage of maturity of the grass is also of significance in this connection, because dry, mature grass is of a more carbonaceous nature than grass in earlier stages of growth.

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